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UNITED STATES DEPARTMENT OF AGRICULTURE

BULLETIN No. 565

Contribution from the Bureau of Chemistry
CARL L. ALSBERG, Chief

Washington, D. C. ▼ May 11, 1918

HOW TO CANDLE EGGS

By

M. E. PENNINGTON, Chief, Food Research Laboratory
M. K. JENKINS, Assistant Bacteriologist
and H. M. P. BETTS, Artist

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INTRODUCTION.

Ability to candle eggs is becoming more and more important to farmers, merchants, and shippers in the country districts.

Laws in many States impose a penalty for selling bad eggs and the Federal Food and Drugs Act prohibits the interstate shipment of cases containing substantial percentages of bad eggs, which are held to be adulterated food. Only by candling can a shipper make certain that his eggs comply with Federal, State, and other regulations.

Aside from its value in enabling one to comply with legal requirements, ability to judge the condition of eggs in the shell has a distinct monetary application and in many sections is simply a matter of economic self-protection for the farmer and the country dealer. The custom of buying eggs on a grading basis is spreading rapidly, and the collectors in the great market centers are becoming much stricter in rejecting inedible eggs, just as consumers are becoming more critical and are refusing to pay for doubtful eggs delivered to them by the retailer. The producer or country shipper who ships uncandled eggs runs the risk, therefore, of losing freight charges and packing costs on all inedible eggs, and where such eggs are included may get

THE ability to candle accurately is becoming of increasing importance to all who are engaged in the production, transportation, and sale of eggs. Buyers are gradually adopting the practice of purchasing eggs on a graded basis as an effective means of reducing the large losses from bad eggs. For the successful operation of such a system a knowledge of candling is indispensable. Furthermore, only by candling can a shipper make certain that his eggs comply with Federal, State, and municipal regulations.

Eggs are graded for market according to their freshness, cleanliness, size, color, and soundness of shell. Freshness, an egg's most important quality, and soundness of shell can be judged best by candling in a dark room. All that is needed is a bright light surrounded by a shield with a small opening before which the egg is held. A kerosene lamp and a piece of stovepipe will suffice for the small candler, but for those who handle large numbers of eggs more elaborate apparatus may prove necessary. Two different kinds of egg-candling devices are illustrated in this bulletin.

The candler must be thoroughly familiar with the structure of the egg. He must know how to hold an egg when candling it. Most important of all, he needs to become acquainted with the principal distinguishing characteristics of each kind of egg found in commerce before he will be able to determine accurately whether a given egg should be graded as marketable or unmarketable. The purpose of this bulletin is to furnish the information required. The candler himself will have to supply the experience.

Sometimes an egg is so near the border line that it is hard to know whether to class it as good or bad. When there is any doubt as to its fitness for food purposes, the candler should reject the egg as inedible; that is, he should give the consumer the benefit of the doubt.

a lower grading and a reduced price for the good eggs he has shipped. The shipper who does not candle his eggs has no check on the candling reports of the consignee and must accept loss off, lowered grading, or other price penalties.

Knowledge of candling and sorting sufficient to sort eggs by the various commercial grades used in the central markets is, of course, a valuable asset to the country collector and shipper. Ability to use the candle at least with accuracy enough to exclude inedible eggs is becoming an accomplishment essential to all who wish to escape legal difficulties and to market their produce on anything like a profitable basis. The detailed descriptions, diagrams, and colored plates in this bulletin, it is believed, will enable producers, dealers, and housewives to distinguish with sufficient accuracy between edible and inedible eggs. The authors caution those who are first attempting to candle for market to give the benefit of the doubt to the consumer and to retain for home use any eggs which appear at all questionable before the candle.

GRADING OF EGGS.

Eggs are graded for market according to freshness, cleanliness, size, color, and soundness of shell. Sorting according to size, color, and cleanliness requires only a visual inspection of the egg while it is being held in the hand. At the same time eggs clearly showing damaged shells may be separated. When the crack is so small that it is not easily seen with the naked eye, it can be detected by candling or by clicking two or more eggs together. A cracked egg tapped lightly against a whole egg gives out a deadened sound, quite different from the clear ring from eggs with unbroken shells. It is comparatively easy to grade eggs according to appearance and soundness of shell, but it requires knowledge and experience to be able to judge the quality of the contents by candling.

THE EGG CANDLE.

The only equipment necessary for candling eggs is a device which consists of a bright light surrounded by a shield having a small opening of sufficient size to receive the egg. Farmers who have few eggs to market can make a candle by using a kerosene lamp as a source of light and a piece of stovepipe about 8 inches long as a shield. The hole should be 1¼ inches in diameter and should be cut in the pipe just opposite the flame in the lamp. Notches, or small openings, should be cut in the bottom of the pipe opposite the hole, to provide air for the lamp. A candle similar to that just described is shown in figure 1.

Handlers of large numbers of eggs, such as hucksters, grocers, and egg shippers, should have a candle made especially for the work. A good candle which can be made by any tinner is illustrated in figure 2. Working drawings are given in figure 3. A strong white electric light should be used in this candle.

FIG. 1.—A stovepipe candle.

THE STRUCTURE OF THE EGG.

Before attempting to candle, the beginner should break a good egg into a saucer and become familiar with its different parts and their arrangement. By comparing the egg in the saucer with figure 4, in which the structure of a typical egg is shown, and following the description given below, the various parts of the egg can be identified easily.

The yolk is contained in a membrane of delicate construction. It varies in color from light yellow to orange, but occasionally is olive green. On the surface of the yolk is a small light-colored circular area called the germinal disk, from which the chick develops. It is present on the yolks of all eggs whether fertile or infertile. The yolk always floats in the white with the chick spot on top. By this provision of nature, the developing chick comes nearest the body of the hen during incubation and on that account receives the most warmth.

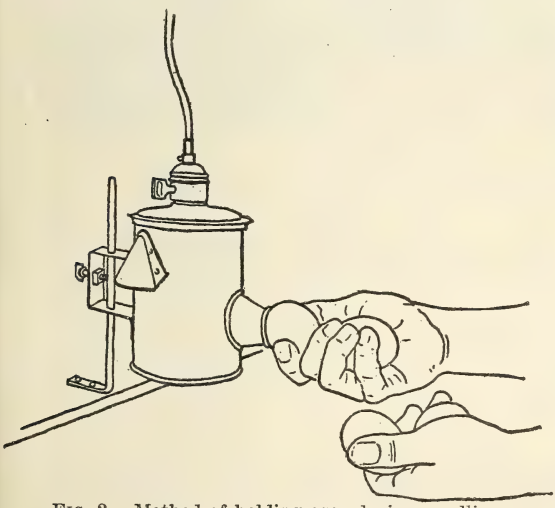

FIG. 2.—Method of holding eggs during candling.

Around the yolk, as indicated in figure 4, lies a small quantity of thin white; then comes a heavy layer of thick white; and outside of this another layer of thin white. Extending from the yolk through the white toward each end of the egg are twisted, cordlike coils of an opaque white material called the chalazæ. These cords may be likened to hammock strings in that they serve to hold the yolk in position, yet allow it to turn freely. The chicken does not come from the chalazæ as is often supposed, but from the germinal disk. The white has a firm, gelatinous consistency, due to a network of interlacing fibers, which are so fine that they can

be seen only by the aid of a microscope. The beating of the egg white brings about the incorporation of air into this fine network of fibers.

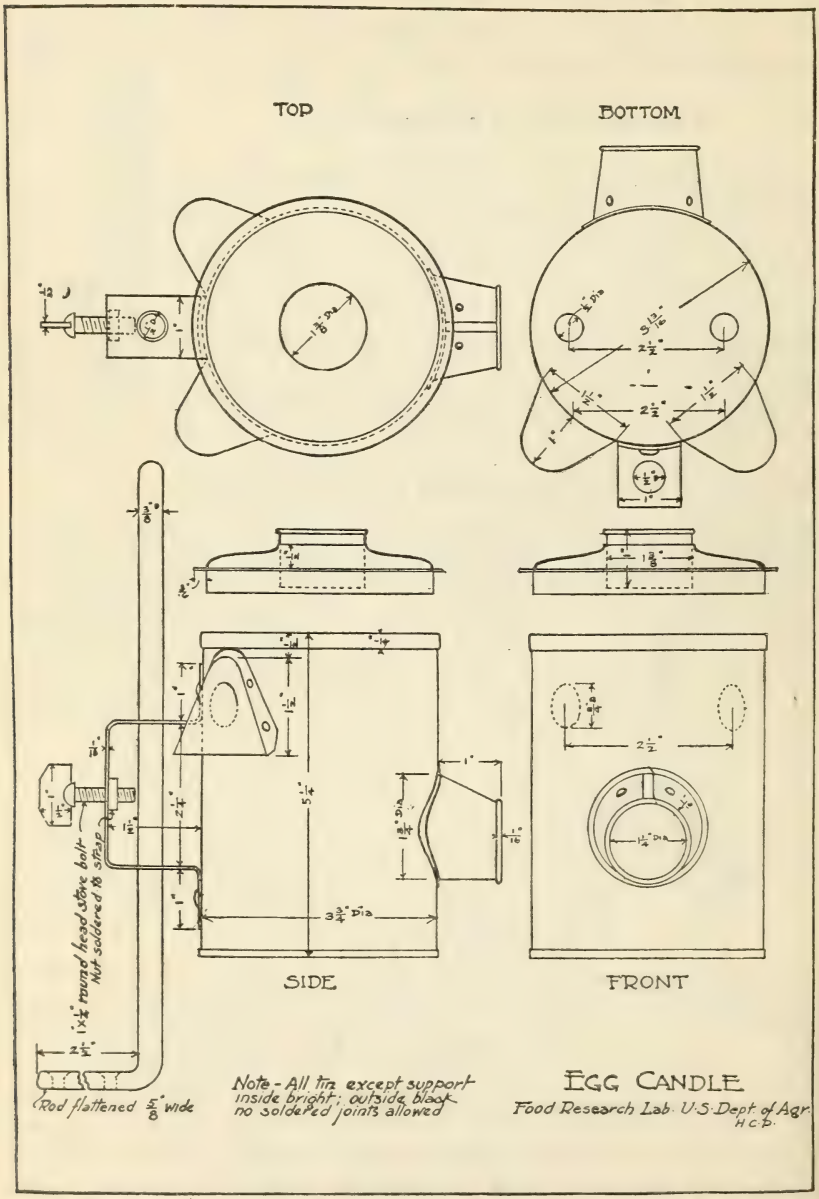
TOP
BOTTOM
SIDE
FRONT
Rod flattened 5/8" wide
1 x 1/4" round head stove bolt Not soldered to strap
Note - All tin except support inside bright; outside black no soldered joints allowed
EGG CANDLE
Food Research Lab. U.S. Dept of Agr.
H.C.D.

FIG. 3.—Working drawings for a one-hole spout candle. (Reproduced from Bul. 5, Missouri State Poultry Experiment Station and U. S. Department of Agriculture, Bureau of Chemistry.)

Between the white and the shell are two fibrous membranes. When the egg is first laid, the contents fill the entire shell. On cooling,

however, the contents shrink and the two membranes separate at the large end of the egg, forming an air space less than three-quarters of an inch in diameter. The outer or shell membrane follows the outline of the shell and is both tougher and thicker than the inner or egg membrane, which follows the outline of the egg contents.

The shell of the egg is porous and varies in color from white to dark brown, depending upon the breed of the hen laying it. The yolk is composed mainly of fat, protein, and water; the white, of protein and water. The yolk sac, shell membrane, and fibers in the white are made of keratin, a material similar chemically to finger nails or the horns or hoofs of animals. The shell is principally carbonate of lime.

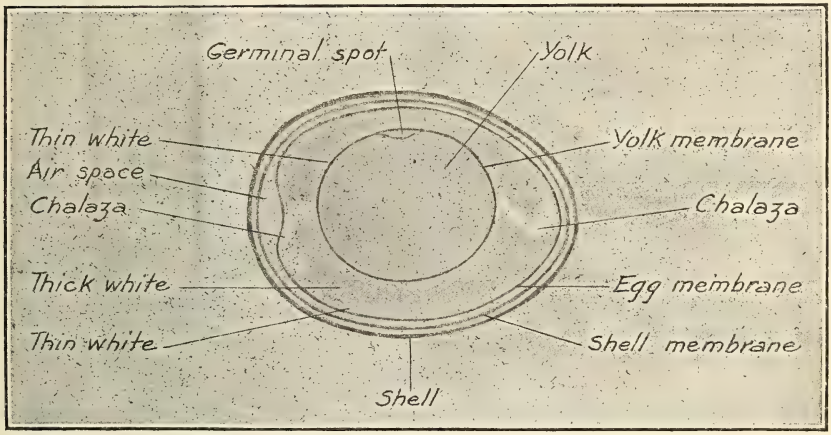

FIG. 4.—Structure of an egg.

HOW TO HOLD AN EGG WHEN CANDLING.

The room in which the candling is done must be dark. The egg is held by hand in a slanting position with the large end against the opening in the candle. A few moderately rapid twists are given to the right and to the left. During this turning, which should be enough to expose the entire surface of the egg to view, the size of the air cell and the condition of the white and yolk should be noted. After this movement the egg should be turned from end to end so that the whole of the egg is again seen. If the egg is not completely turned before the candle bad eggs, such as those containing mold spots or yolks stuck to the shell, may not be detected. In other words, one side of an egg may appear good on candling, but the other side may be found to be bad if brought into view.

It is customary to pick up two eggs in each hand, supporting one egg at a time in the tips of the thumb and the first two fingers (see fig. 2). Each egg should be candled separately. After the foremost egg in each hand has been candled, it is dropped back into the palm

and the other two eggs are brought forward by a dexterous movement of hand and palm, held before the light, and graded. The ability to shift two eggs in each hand makes for more rapid work and may be acquired by practicing with china eggs. A good deal of experience is required to shift eggs safely and quickly.

During candling the egg should come in contact with the fingers as little as possible, so that small blemishes such as mold spots will not be hidden from view. It is advisable not to hold more than two eggs in each hand during candling because of the added chance of breaking the eggs and confusing the grades.

Until the beginner has had some experience it will be advisable for him frequently to check the decision reached by candling with the appearance of the egg when broken into a saucer or other convenient receptacle.

WHAT TO LOOK FOR IN CANDLING AN EGG.

The relation of the shell, air space, white, and yolk to grading by candling will be discussed separately before taking up the consideration of the different kinds of eggs. After the beginner has become acquainted with the different factors which influence the grading of an egg, it is a comparatively simple matter for him to recognize the predominating characteristics of each egg and to place the egg in its proper grade.

THE SHELL.

It is possible to grade eggs by inspection through the shell because of the partial transparency of the shell when held before a light in a dark room. The egg contents can be seen much more plainly through a white shell than through a brown one. The light shining through a white egg, on candling, is yellow, with a slightly pinkish tinge; that from a brown egg is much pinker; and that from a dark brown egg is almost red. In each instance, the color deepens in the region of the yolk. The contrast between the white and the yolk is much greater in white than in brown eggs. The appearance before the candle of a fresh white and a fresh brown egg is shown in Plates I and II. The beginner should study eggs with white shells first and postpone the study of eggs with brown shells until he has had some experience. Likewise he should begin with clean eggs, for the reason that dirt or stains on the shell may cast a shadow on the contents and thus render accurate candling difficult. Candling of eggs with mottled, warty, or uneven shells should also be deferred.

The colored sketches of the different kinds of eggs shown in this bulletin were made, with few exceptions, from eggs with white shells, and were selected to show as much of the interior as possible. The descriptions in most instances will apply to white eggs. These facts

should be taken into consideration when comparing the illustrations and descriptions with the appearance of eggs before the candle.

Candling will enable one to identify cracked eggs more accurately than will clicking. Therefore, when eggs are graded by candling to judge the quality of the contents, those with damaged shells can be removed at the same time. If there are a few small holes in the candle to shed light on the egg container below, dirty eggs can be picked out with but one handling of the eggs. Eggs with mold growing in the cracks are detected to some extent by candling, but much more readily away from the candle. (See Pl. IV, fig. 2.)

THE AIR SPACE.

The air space of a fresh egg is less than three-fourths inch in diameter, as may be seen by tilting an egg with the large end in front of a candle. As the egg ages the air space increases in size, owing to the evaporation of water from the liquid contents. The amount of evaporation depends very largely upon the age of the egg and the temperature at which it has been kept. In winter and spring eggs shrink more slowly than in summer. Therefore, the early spring eggs on the market will have smaller air spaces than the summer eggs. With continued shrinkage the egg membrane pulls away from the shell membrane at the air space, so that when the egg is turned before the candle the lower wall of the air cell changes at the same time. This condition is shown in Plate XI. In grading an egg the size of the air space is useful in determining its freshness. For example, a full egg will be graded as a "first" and a shrunken egg as a "second." Most bad eggs have enlarged air cells. The variations in the size of the air space of eggs of different grades are shown in Plates I and XII.

The egg membrane, which forms the lower wall of the air cell, may become broken by jars or jolts during the haul to market, or by severe shaking in the hand or other rough handling. When this membrane is broken the air cell always rises, irrespective of the position in which the egg is held, as may be seen from Plate IV, figure 1. Small bubbles of air frequently are seen when the egg is turned before the candle. When an egg becomes very stale the air in the air cell may move all the way around the egg between the two membranes. Such an air cell is termed "movable." Eggs with broken and movable air cells are graded as "seconds," if otherwise good, even though they may show no shrinkage.

THE WHITE.

The two factors to be considered when studying the white of an egg before the candle are its firmness and its color. A firm, thick white is found in a fresh egg, and a weak, thin white in a stale egg,

or in one which has been exposed to warm temperatures, as in summer or by incubation. The condition of the white is indicated on candling by the ease with which the yolk moves when the egg is rotated. For example, in a fresh egg the white is so firm that the yolk sways but little during candling, whereas in an egg with a weak white the yolk moves much more rapidly. A further indication of a thin white is seen on candling by the ease with which the white moves at the air cell, which usually is enlarged. Out of the shell the difference between a firm and a thin white is detected easily by pouring the egg from one dish to another. As an egg becomes stale the amount of thick white decreases and the amount of thin white increases.

Out of the shell the white of the fresh egg has an opalescent tinge, which characteristic is lost when an egg becomes stale. Eggs are found sometimes in which the white is as thin as water. Such eggs, however, are encountered rarely in ordinary candling. They are detected by the exceedingly rapid motion of the yolk when the egg is turned before the candle and by the very watery appearance of the white at the air cell, which usually is broken. The watery condition is caused, in most instances, by bacteria which penetrate the shell when it is broken or wet and grow in the egg material, destroying the mechanical structure of the white. When such eggs are opened the white flows out as readily as water and may be colorless, although usually it is a yellowish brown. The odor is bad and ammonia frequently is detected. Eggs with whites thus liquefied are inedible.

Several classes of bad eggs are indicated by discolored whites. Of these, eggs with yellow, bloody, moldy, and green whites are the most numerous.

A yellow white represents one of the most common forms of egg deterioration and is caused by the disintegration of the yolk. The whites assume a clouded yellow color before the candle, the depth of the color depending upon the amount of yolk present. (See Pl. VI.)

Eggs with bloody whites are comparatively rare. They occur most frequently among pullets' eggs in spring and fall and are caused by rupture of blood vessels of the hen during the passage down the oviduct of the egg before it is covered with the shell. The blood may be present in the egg in the form of clots attached to the yolk or distributed through the white. Such eggs are detected on candling by the red color of the white and by the clots which appear as irregular-shaped bodies floating in the egg. (See Pl. X.) If eggs with bloody whites are inclosed in white shells, the red color is detected easily by candling; if they are inclosed in brown shells, it is not so easy to distinguish between the deep pink color caused by the shell and the red color due to the presence of blood. An orange-colored yolk also may make it difficult to detect an egg with a bloody white.

Green-white eggs[1] are caused by bacteria which have penetrated a damaged or wet shell. These organisms grow in both the white and the yolk, producing in the former a very characteristic green color. Only in exceptional cases is the egg shell sufficiently transparent for the green color of the white to be seen by candling. Eggs with green whites represent one of the few kinds of bad eggs which can not be determined by inspection through the shell.

Mold may penetrate a wet, broken shell and attach itself to the inner surface in the form of irregular patches. If the growth takes place at low temperatures, the affected portions of the white are gelatinized. These mold spots appear as dark areas before the candle, and are seen easily if not covered with the fingers. (See Pls. IV and XII.)

Foreign bodies, such as meat spots, grain, gravel, or worms, may be included in the egg in its passage down the oviduct. Before the candle they appear as dark spots moving in the white.

THE YOLK.

The conditions to be noted when studying the yolk may be divided into two classes, namely, those relating to ordinary decay and those pertaining to changes taking place during hatching.

CHANGES IN THE YOLK DUE TO DECAY.

The condition of the yolk is one of the most important factors to be determined when judging the quality of eggs by candling. When a fresh egg is twirled before the candle the yolk is dimly seen as a dark and shadowy object moving slowly in the white. The more transparent the shell the more distinctly is the yolk seen. The yolk sac is so strong and the white so firm that the spherical form of the yolk is altered very little when the contents of the egg are set in motion by the turning during candling.

Because of the thinner condition of the white, the yolk of a stale egg is seen much more plainly on candling than that of a fresh egg. As the egg ages the yolk sac weakens, and since the white becomes thinner at the same time the outline of the yolk is seen to change when the egg is rotated. When such an egg is opened the yolk flattens out and often breaks. The differences in the strength of the yolk sac of eggs of varying degrees of freshness are indicated clearly in Plates I and III. If eggs which have weak yolks before the candle show whole yolks when opened, they are graded as good if no other cause for rejection is observed.

When the yolk of an egg is so weak that a shake in the hand causes it to break and mix with the white, the egg should be graded

[1] Illustrated in color in U. S. Dept. Agr. Bul. 51, Pl. VIII.

as unmarketable, for during shipment it is very likely to become unfit for food. These eggs are difficult to grade accurately by candling. They are of such inferior quality, however, that in case of doubt they should be classed as inedible.

The yolk sac may so weaken that the yolk seeps or strains through into the white. In these eggs the yolk would appear whole before the candle, but it would be weak, and the white would have a cloudy, yellow color. Out of the shell the yolk will be seen to be flattened and sometimes mottled and the white to be streaked with yolk. Very close candling is required to detect these eggs, and since they are border-line eggs, in which further deterioration is very rapid, they should not be graded as marketable.[1]

The more common form of disintegration of the yolk takes place through the rupture in one or more places of the yolk sac and the mingling of the white and yolk. This mixing is commonly known as "addling." All degrees of addling may be found, from the egg in which the yolk is just beginning to mix with the white to the egg in which no vestige of white is seen. The eggs representing the early stage of mixing are called "mixed rots," and those representing the later stage, "white rots." Both are inedible.

Mixed rots are characterized on candling and out of the shell by the irregular mixture of white and yolk. Often one portion of the yolk shows more deterioration than another, a condition shown by a darkened area on candling and by whitish streaks out of the shell. (See Pl. VI.)

The characteristics noted for mixed rots are even more marked in the white rots. In these eggs the white assumes a general yellow appearance on candling and out of the shell. (See Pl. VII.)

The incrusting of the yolk is a characteristic form of deterioration among eggs with soiled shells which have been held in cold storage. Under certain conditions the bacteria enter the shell, liquefy the white, making it watery, and produce a coating or crust on the yolk. Before the candle the yolk appears to have dark, mottled areas. Such eggs are unfit for food.

The position of the yolk also must be taken into consideration when grading eggs by candling. In a fresh egg the yolk is slightly above the center in the large end of the egg. Although lighter than the white, it does not float against the shell because the chalazæ tend to hold it in a central position in the egg. As the egg becomes stale with age, and especially from exposure to heat, the white is weakened, thereby making it possible for the yolk to float near the shell. This condition indicates staleness if the egg shows shrinkage.

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[1] An illustration of an egg with a seeping yolk is published in U. S. Dept. Agr. Bul. 224, Pl. XVI.

As aging continues, the yolk may adhere slightly to the shell, but a quick twist of the egg may set the yolk free without breaking it. In such a case the egg is edible, but a very low grade. With further aging the yolk will stick to the shell so that it can not be separated without breaking the yolk sac, in which case the egg is classed as bad. (See Pl. XI.) When the yolk is thus broken, as may happen when the egg is turned quickly, the appearance of the egg before the candle is the same as that of a mixed rot. Again, the yolk may be adherent at one point and broken at another. These eggs deteriorate quickly into mixed or white rots.

Dampness may be another factor causing the yolk to stick to the shell. In this case molds penetrate the shells as far as the yolk, which becomes very heavily attached to the shell, as shown in Plate XII.

The color of the yolk affects the color of the light passing through the egg from the candle in much the same way as does the color of the shell. For example, an egg with a light-yellow yolk will reflect a pink-yellow light when held before the candle, and an egg with an orange yolk a red light. Sometimes eggs with olive-colored yolks are found. These reflect a green color from the yolk, which characteristic has given them the name of "grass eggs." (See Pl. V.) The color of the yolk is not considered in the grading of eggs by the candle, except in the case of "grass eggs," which are classed as "seconds," because their color is abnormal.

CHANGES IN THE YOLK DUE TO HATCHING.

A few hours' incubation under the hen or exposure to warm temperatures, as in summer, is sufficient to start the hatching of a fertile egg. In its early stages this condition can be detected on candling by the reddish glow of the area surrounding the germinal spot, which in this stage of development is termed a "hatch spot." This is very plainly seen when the egg is opened. A hatch-spot egg before the candle and out of the shell is shown in Plate III. An egg in which the hatching has progressed to this stage is considered edible but is graded as a "second."

Blood forms if incubation continues. At this stage in the development of the embryo, the egg is considered inedible. A fertile egg containing blood, due to hatching, is termed a "blood ring." Such eggs are detected on candling by the circle, or portion of a circle, of blood present around the reddish hatch spot area of the yolk. (See Pl. VIII.) If the embryo does not die, and conditions of incubation are favorable, the different stages of development from the forming of blood veins to the growing of the mature chick can be followed by observation before the candle. After the embryo chick begins to

take form it appears black on candling. (See Pl. IX.) An egg containing a large embryo can not be distinguished from a black rot, except by the absence of motion of the contents when the egg is turned during candling. Practically all incubated fertile eggs found in the candling of eggs for market contain dead embryos.

After the embryo has died the contents of the egg are subject to all the changes making for deterioration which have been described for the white and yolk. For example, a yolk bearing a blood ring may adhere to the shell or disintegrate and mix with the white. The yolk of a partially hatched egg usually attaches itself to the shell by the hatch spot or blood ring.

CLASSIFIED DESCRIPTION OF EGGS BEFORE THE CANDLE AND OUT OF THE SHELL.

The different types of eggs found in commerce may be classified according to edibility and possibility of detection by candling as follows:

TABLE 1.—*Eggs classified according to edibility and possibility of detection by candling.*

EGGS THAT CAN BE DETECTED BY CANDLING.

EDIBLE.		INEDIBLE.	
Kind.	Illustrated in Plate No.	Kind.	Illustrated in Plate No.
Fresh egg.	I, II	Black rot.	IV
Hatch-spot egg.	III	Egg with seeping yolk.	
Stale egg.		Mixed rot.	VI
Weak egg.		White rot.	VII
Egg with movable air cell.[1]	IV	Blood ring.	VIII
Egg with double yolk.[1]		Egg with large embryo.	IX
Egg with olive-colored yolk.[1]	V	Egg with bloody white.	X
		Egg with slightly stuck yolk.	XI
		Egg with heavily stuck yolk.	
		Moldy egg.	IV, XII
		Egg with crusted yolk.	
		Egg containing blood spots or other foreign bodies.[2]	
		Egg with heavily mottled yolk.	

[1] Edible if there is no deterioration. [2] Sometimes edible on removal of body.

EGGS THAT CAN NOT BE DETECTED BY CANDLING.

INEDIBLE.
Kind.
Egg with green white.
Musty egg.
Sour egg.

A brief description of the appearance of each type of egg before the candle and out of the shell is given in the following pages. The principal distinguishing characteristics also are given. These tabulated descriptions, in conjunction with the table and the illustrations,

can be used as a working guide in the candling of eggs. The terms used to express the specific condition of the eggs are defined in the general description of shell, white, and yolk, as discussed on pages 6 to 12.

FRESH EGG.[1]

(Plates I and II.)

BEFORE THE CANDLE.

Air space: Not enlarged; less than three-fourths inch in diameter.
White: Firm and clear.
Yolk: Dimly seen through the white as a shadowy object indistinct in outline. The chick spot is not visible.
Distinguishing characteristics: No shrinkage and general firm conditions of white and yolk.

OUT OF THE SHELL.

White: Firm and thick; opalescent; reflects the light.
Yolk: Spherical and firm; chick spot small with no sign of hatching. Color is uniform for the entire yolk, but varies in color from light yellow to deep orange, and is occasionally olive green.
Distinguishing characteristics: General firm condition of white and yolk. White, opalescent.

Edible.

HATCH-SPOT EGG.

(Plate III.)

BEFORE THE CANDLE.

Air space: Usually enlarged.
White: Thin and clear.
Yolk: A distinct reddish glow around the germinal spot, which is visible; usually located above the middle of the egg.
Distinguishing characteristic: Reddish glow on the yolk.

OUT OF THE SHELL.

White: Thin and clear; no opalescence; does not reflect the light as strongly as does a fresh egg.
Yolk: Bears a hatch spot; is flattened, being especially weak around the embryo.
Distinguishing characteristic: Hatch spot on the yolk.

Edible.
Occurrence: Chiefly during warm weather or hatching season.

STALE EGG.[2]

BEFORE THE CANDLE.

Air space: Enlarged; the lower wall may be movable in outline.
White: Thin and clear.
Yolk: Definite in outline; sometimes weak, and may occasionally have dark, mottled areas.
Distinguishing characteristics: Enlarged air cell and increased contrast between white and yolk as compared with a fresh egg.

OUT OF THE SHELL.

White: Thin; no opalescence; does not reflect the light as much as does a fresh egg.
Yolk: Flattened, and occasionally may have light, mottled areas.
Distinguishing characteristics: Thin white and flattened yolk.

Edible.
Occurrence: Among eggs not marketed promptly.

[1] The color of a white egg before the candle is yellow with a pinkish tinge, that of a brown egg is pinker, and that of a dark brown egg is almost red. In each instance the color deepens in the region of the yolk.

[2] Illustrated in color in U. S. Dept. Agr. Bul. 51, Pl. III.

WEAK EGG.[1]

BEFORE THE CANDLE.

Air space: Enlarged; lower wall usually movable in outline.
White: Very thin and clear.
Yolk: Whole, but very weak; may bear a hatch spot and may be mottled.
Distinguishing characteristic: A weak condition of white and yolk.

OUT OF THE SHELL.

White: Clear and very thin.
Yolk: Membrane often breaks when the egg is opened; may have a hatch spot and may be mottled.
Distinguishing characteristic: Yolk sac often breaks when egg is opened.

Edible.
Occurrence: Chiefly during summer.

EGG WITH MOVABLE AIR CELL.

(Plate IV, figure 1.)

BEFORE THE CANDLE.

Air space: Always on top no matter in what position the egg is held.
White and yolk: Fresh, stale, or deteriorated.
Distinguishing characteristics: Movable air cell; much less contrast between white and yolk in a weak egg than in a fresh egg; gives a hollow sound when tapped against the shell of an egg with normal air cell.

OUT OF THE SHELL.

White and yolk: Fresh, stale, or deteriorated.
Distinguishing characteristic: None.

Edible if contents have not deteriorated.
Occurrence: During autumn, when the proportion of stale eggs is the greatest, and in those sections where eggs are subject to rough handling.

MOLDY CRACKED EGG.

(Plate IV, figure 2.)

For description see page 18.

BLACK ROT.

(Plate IV, figure 3.)

BEFORE THE CANDLE.

Air space: Very much enlarged; lower wall may be movable in outline or may be broken.
Contents of shell: Gray or black in color.
Distinguishing characteristic: Black color.

OUT OF THE SHELL.

The color of the mixture varies from gray-green to dirty yellow. It may contain a decomposed embryo.
Distinguishing characteristic: Discolored mixture with bad odor.

Inedible.
Occurrence: Most frequently during spring and late summer months.

[1] Illustrated in color in U. S. Dept. Agr. Bul. 224, Pl. XIV.

EGG WITH DOUBLE YOLK.

BEFORE THE CANDLE.

Air space: Small or enlarged.
White: Fresh, stale, or deteriorated.
Yolk: Two yolks floating in the white.
Distinguishing characteristics: Double yolk, and egg is usually very large.

OUT OF THE SHELL.

White: Fresh, stale, or deteriorated.
Yolk: Two yolks.
Distinguishing characteristic: Two yolks.

Edible if deterioration has not taken place.
Occurrence: Infrequent.

EGG WITH OLIVE-COLORED YOLK.

(Plate V.)

BEFORE THE CANDLE.

Air space: Small or enlarged.
White: Fresh, stale, or deteriorated.
Yolk: Olive or greenish yellow in color.
Distinguishing characteristic: A greenish cast to whole egg, deepening in the region of the yolk.

OUT OF THE SHELL.

White: Fresh, stale, or deteriorated.
Yolk: Olive or greenish yellow in color.
Distinguishing characteristic: Olive-colored yolk.

Edible if deterioration has not taken place.
Occurrence: Most frequently in spring, but may be seen throughout the year.

EGG WITH SEEPING YOLK.[1]

BEFORE THE CANDLE.

Air space: Usually enlarged; the lower wall may be movable in outline.
White: Yellow, due to seepage of yolk through defective yolk sac.
Yolk: Very weak, and may show dark, mottled areas.
Distinguishing characteristics: Yellow white and uneven coloring of yolk if mottled.

OUT OF THE SHELL.

White: Thin and partially or entirely streaked with yellow.
Yolk: Flattened and very weak, and may be mottled.
Distinguishing characteristic: Seeping yolk.

Inedible.
Occurrence: A common form of deterioration during entire year.

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[1] Illustrated in color in U. S. Dept. Agr. Bul. 224, Pl. XVI.

MIXED ROT.

(Plate VI.)

BEFORE THE CANDLE.

Air space: Enlarged; the lower wall may be movable in outline.
White: Unevenly streaked with yellow; thin.
Yolk: Yolk sac broken in one or more places and contents flowing into the white. Dark areas may be seen in the liquid.
Distinguishing characteristic: Streaked appearance of contents due to mixing of white and yolk.

OUT OF THE SHELL.

White: Thin and unevenly streaked with yellow.
Yolk: Broken and partially mixed with the white; may contain whitish streaks.
Distinguishing characteristic: Partially addled contents.

Inedible.
Occurrence: A very common form of deterioration during entire year.

WHITE ROT.

(Plate VII.)

BEFORE THE CANDLE.

Air space: Enlarged; lower wall may be movable.
White and yolk: Mixed. giving general yellow color to contents.
Distinguishing characteristic: More or less uniform mixture of white and yolk.

OUT OF THE SHELL.

White and yolk: Mixed together more or less completely. Has usually a stale or a sour odor.
Distinguishing characteristic: Addled appearance.

Inedible.
Occurrence: A very common form of deterioration during entire year.

EGG WITH BLOOD RING.

(Plate VIII.)

BEFORE THE CANDLE.

Air space: Large or small.
White: Thin and clear.
Yolk: A distinct reddish glow on one side of the yolk, in which is seen a blood ring or portion of ring.
Distinguishing characteristic: Presence of blood in region showing reddish glow.

OUT OF THE SHELL.

White: Thin and clear.
Yolk: Germinal spot enlarged and surrounded by complete or partial blood ring; yolk flattened and often very weak.
Distinguishing characteristic: Blood ring on yolk.

Inedible.
Occurrence: During warm weather or hatching season.

EGG WITH LARGE EMBRYO.

(Plate IX.)

BEFORE THE CANDLE.

Air space: Enlarged.
White: Thin and clear.
Yolk: Covered with a network of blood vessels, in the center of which the embryo is beginning to take, or has taken, form. The embryo is seen as a dark body on the yolk, its size depending upon the period of incubation. With age, the blood vessels may become faded. The yolk may or may not be broken.
Distinguishing characteristics: The network of blood vessels and the dark body on the yolk, which usually is broken.

OUT OF THE SHELL.

White: Thin and clear unless the yolk is broken.
Yolk: Covered with a network of blood vessels, in the center of which is the body of the embryo. The yolk may or may not be broken.
Distinguishing characteristic: Size of embryo.

Inedible.
Occurrence: During the hatching season and during warm weather.

EGG WITH BLOODY WHITE.

(Plate X.)

BEFORE THE CANDLE.

Air space: Small or enlarged.
White: Red in color, very often containing clots of blood which occur as irregular-shaped bodies moving through the white.
Yolk: Usually intact.
Distinguishing characteristic; A general reddened appearance, particularly in the white.

OUT OF THE SHELL.

White: Mixed with blood; sometimes clots are present.
Yolk: Normal for grade of egg, but may bear blood clots.
Distinguishing characteristic: Blood in white.

Inedible.
Occurrence: Infrequent at all seasons of the year; most common in early spring and late autumn when pullets begin to lay.

EGG CONTAINING BLOOD CLOTS OR OTHER FOREIGN BODIES.

BEFORE THE CANDLE.

Air space: Small or enlarged.
White: Blood clots and foreign bodies appear as irregular-shaped dark-colored bodies floating in the white.
Yolk: Usually intact.
Distinguishing characteristic: Dark bodies floating in the white.

OUT OF THE SHELL.

White: Pieces of flesh, grain, gravel, or even feces or worms may be attached to the yolk or floating in the white.
Distinguishing characteristic: Blood clots or foreign bodies in the white.

Inedible, except in the case of eggs containing small clots of blood or small pieces of meat, which are easily removed when the egg is opened.
Occurrence: Infrequent.

EGG WITH YOLK SLIGHTLY STUCK TO THE SHELL.

(Plate XI.)

BEFORE THE CANDLE.

Air space: Enlarged; lower wall may be movable in outline.

White: Thin, may be streaked with yellow if yolk sac is ruptured.

Yolk: Attached to shell by a small area of the yolk sac; waves when egg is turned; as the yolk sac is weak, it frequently may be found to be ruptured, with contents flowing into the white, or twisting during candling may tear the yolk from the shell, when the appearance before the candle will be similar to that of a mixed rot. Occasionally, if the yolk has just begun to stick to the shell, turning the egg in front of the candle may free the yolk without breaking its sac, when it is graded as a good egg.

Distinguishing characteristic: The sticking of the yolk by a small area so that it sways easily when the egg is turned.

OUT OF THE SHELL.

White: Thin and clear, or may be streaked with yellow if yolk is broken.

Yolk: If whole in the shell, it is broken when the egg is opened, leaving a yellow mark on the shell at place of contact. If yolk was both stuck and broken in the shell, it will have the appearance of a mixed rot when removed from the shell. If yolk was very lightly stuck it might drop out of the shell without breaking, in which case the egg would be classed as good.

Distinguishing characteristic: A broken yolk and a yellow mark on the shell where the yolk is stuck.

Inedible.

Occurrence: Very common in summer and autumn.

MOLDY EGG.

(Plate IV, figure 2; Plate XII.)

BEFORE THE CANDLE.

Air space: Enlarged; lower outline may be movable.

White and yolk: Mold shows as black or grayish areas inside shell. If egg is damaged, the growth follows the line of the crack. The growth may be confined to the shell, in which case the contents of the egg will appear normal; or it may be in the air cell or the white, in which case its presence is detected by dark-colored patches; or it may extend to the yolk, which in this stage is heavily attached to the shell and covered with dark spots. In an advanced stage of mold growth the whole egg may appear black.

Distinguishing characteristic: Black patches of mold growth.

OUT OF THE SHELL.

White and yolk: Normal, if the mold growth has not extended beyond the shell. If the mold is growing in the white it is seen as small patches on the shell, and the yolk may be whole but is usually weak. Sometimes the shell is colored blue or red by the mold growth. If the mold has invaded the yolk so that it sticks to the shell, it then has the appearance of an egg with a heavily stuck yolk.

If the mold growth has taken place in cold temperatures, the infected areas will be gelatinous.

Distinguishing characteristic: Infected areas either dark in color or gelatinized.

Inedible.

Occurrence: Throughout the year among eggs held in damp surroundings.

[1] Illustrated in color in U. S. Dept. Agr. Bul. 224, Pl. XV.

EGG WITH HEAVILY STUCK YOLK.[1]

BEFORE THE CANDLE.

Air space: Enlarged; lower wall may be movable in outline.
White: Very thin.
Yolk: Stuck to the shell by a large area of the yolk sac and does not wave when the egg is turned; the color at point of contact is very much darkened.
Distinguishing characteristics: Firm attachment of yolk to shell and dark color at place of contact.

OUT OF THE SHELL.

White and yolk: More or less mixed together; a large portion of the yolk remains attached to the shell.
Distinguishing characteristic: Heavily adherent yolk.

Inedible.
Occurrence: Throughout the year among eggs held in damp surroundings.

EGG WITH HEAVILY MOTTLED YOLK.

BEFORE THE CANDLE.

Air space: Small or enlarged.
White: Usually weak.
Yolk: Bears dark mottled areas and is frequently weak.
Distinguishing characteristic: Dark mottled areas on yolk.

OUT OF THE SHELL.

White: Usually weak.
Yolk: Streaked with different shades of yellow; sometimes watery areas are present.

Inedible.
Occurrence: Chiefly among summer eggs and eggs held at low temperatures.

MUSTY EGG.

OUT OF THE SHELL.

White: Fresh, stale, or deteriorated.
Yolk: Stale or deteriorated.
Distinguishing characteristic: Musty odor.
Inedible.
Occurrence: Among eggs held in damp surroundings.

SOUR EGG.

OUT OF THE SHELL.

White: Thin, and is frequently cloudy.
Yolk: Weak and often broken.
Distinguishing characteristic: Sour odor.
Inedible.
Occurrence: During entire year.

EGG WITH GREEN WHITE.

OUT OF THE SHELL.

White: Clear and distinctly green in color.
Yolk: Flattened and sometimes very weak.
Odor: May or may not be pleasant.
Distinguishing characteristic: Green white.
Inedible.
Occurrence: Throughout the entire year, but chiefly in spring among dirty, washed, and cracked eggs, when the weather is damp.

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[1] Illustrated in color in U. S. Dept. Agr. Bul. 224, Pl. XV.

EGG WITH CRUSTED YOLK.

BEFORE THE CANDLE.

Air space: Enlarged, usually broken.
White: Decidedly watery and frequently yellowish in color.
Yolk: Crusted and weak.
Distinguishing characteristics: Watery condition of white and dark spots on yolk.

OUT OF THE SHELL.

White: Extremely watery and usually yellowish in color.
Yolk: Covered with a light colored crust, which has a tendency to flake off.
Odor: Putrid, frequently resembling ammonia.
Distinguishing characteristics: Crusted yolk and watery white.

Inedible.

Occurrence: Chiefly among dirty and washed eggs held in cold storage.

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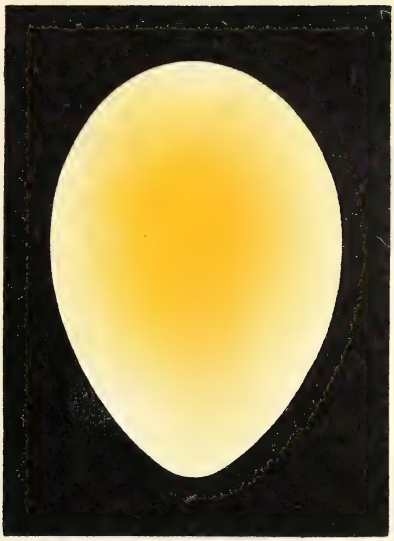

A FRESH EGG WITH WHITE SHELL BEFORE THE CANDLE AND OUT OF THE SHELL

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MEDIUM BROWN SHELL FRESH EGG IN DAYLIGHT AND BEFORE THE CANDLE

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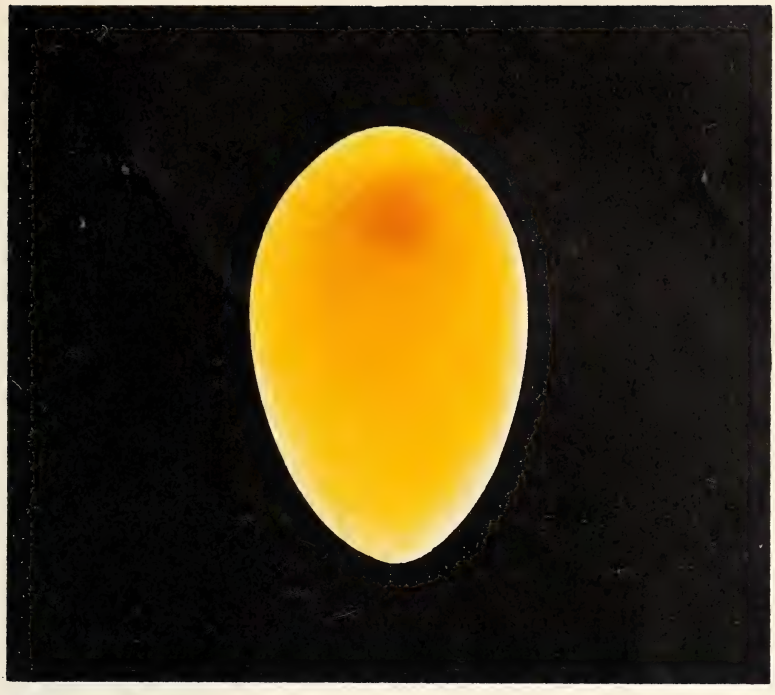

HATCH SPOT EGG BEFORE THE CANDLE AND OUT OF THE SHELL

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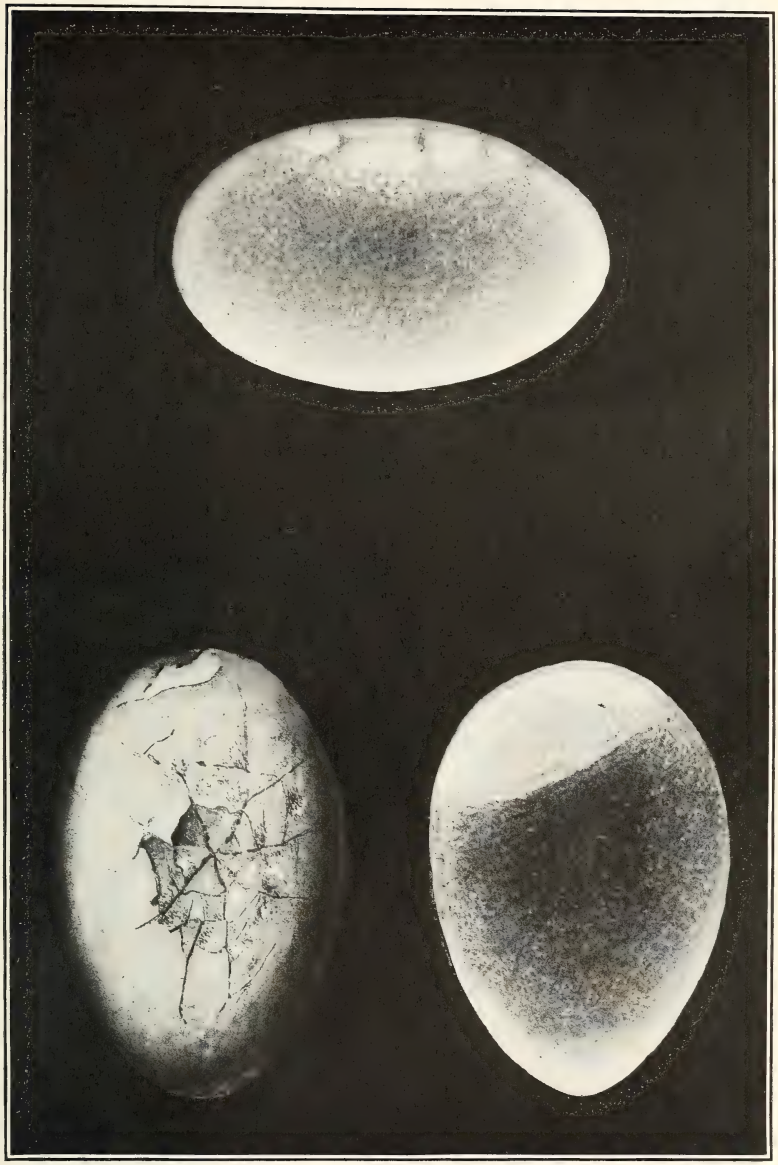

UPPER FIGURE: EGG WITH MOVABLE AIR CELL BEFORE THE CANDLE. LOWER: LEFT, MOLDY CRACKED EGG IN DAYLIGHT; RIGHT, BLACK ROT BEFORE THE CANDLE.

H.M.P. Betts

EGG WITH OLIVE COLORED YOLK BEFORE THE CANDLE AND OUT OF THE SHELL

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MIXED ROT BEFORE THE CANDLE AND OUT OF THE SHELL

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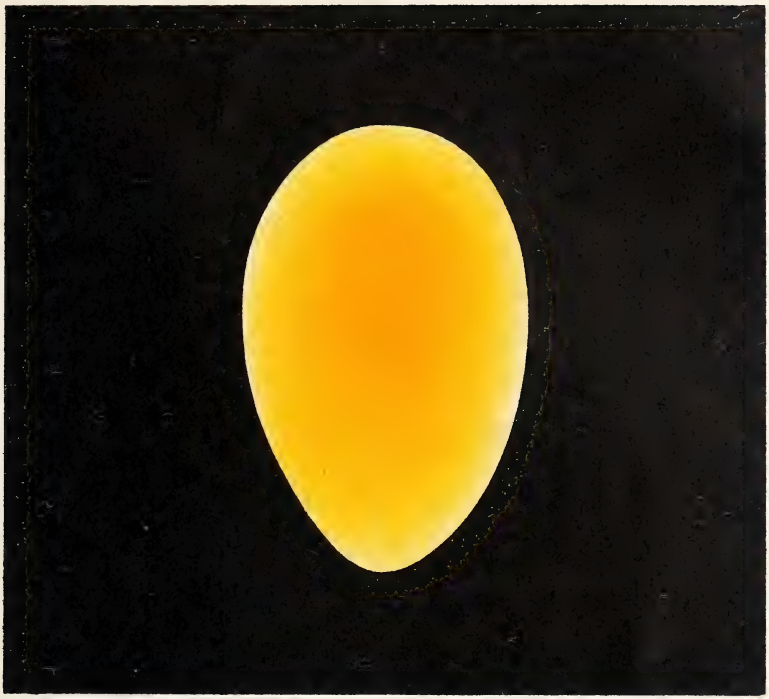

WHITE ROT OR ADDLED EGG
BEFORE THE CANDLE AND OUT OF THE SHELL

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EGG SHOWING "BLOOD RING"
BEFORE THE CANDLE AND OUT OF THE SHELL

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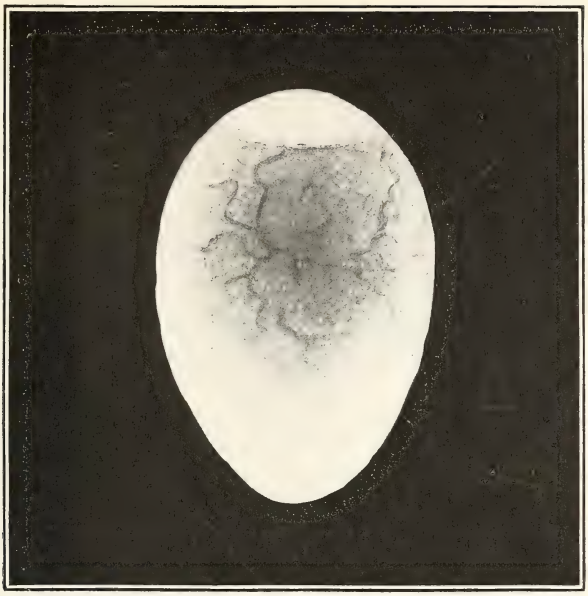

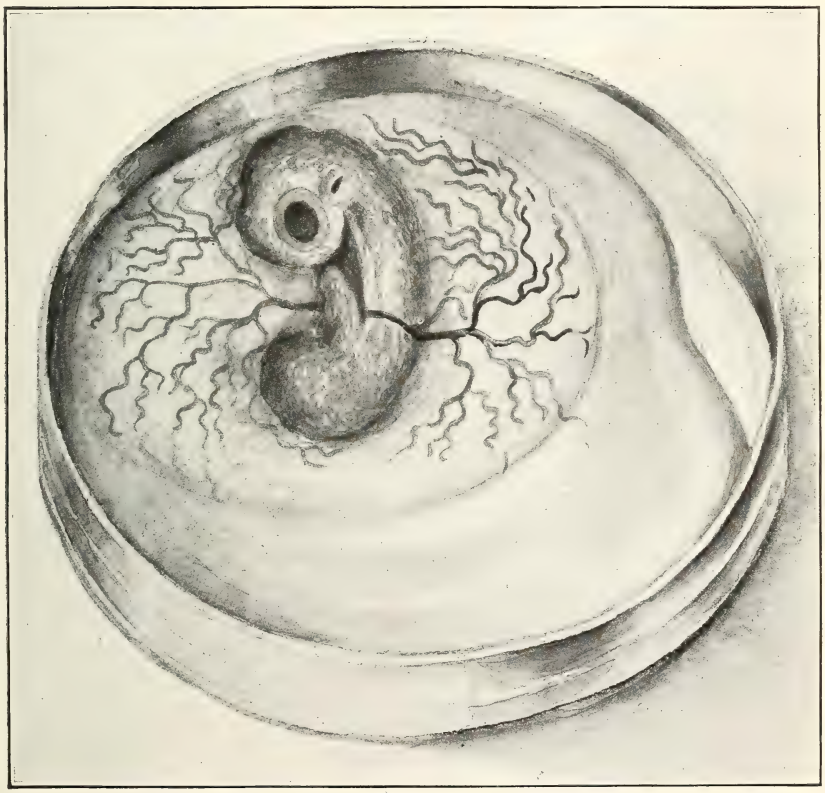

EGG WITH LARGE EMBRYO BEFORE THE CANDLE AND OUT OF THE SHELL.

EGG WITH BLOODY WHITE BEFORE THE CANDLE AND OUT OF THE SHELL

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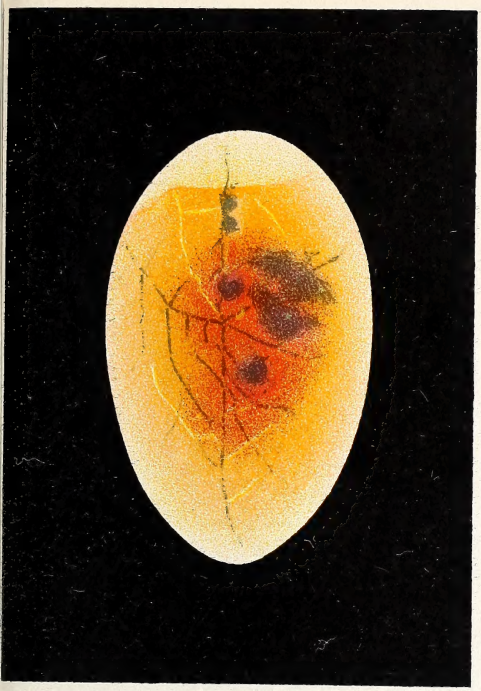
EGG WITH YOLK SLIGHTLY STUCK TO THE SHELL BEFORE THE CANDLE AND OUT OF THE SHELL.



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MOLDY CRACKED EGG WITH DETERIORATED CONTENTS
BEFORE THE CANDLE AND OUT OF THE SHELL

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